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(71) Applicant *(for all designated States except US)*: **HTE AKTIENGESELLSCHAFT THE HIGH THROUGHPUT EXPERIMENTATION COMPANY** [DE/DE]; Kurpfalzring 104, 69123 Heidelberg (DE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **ZECH, Torsten** [DE/DE]; Obere Seegasse 42, 69124 Heidelberg (DE). **SCHUNK, Stephan, Andreas** [DE/DE]; Kaiserstrasse 59, 69115 Heidelberg (DE). **HAAS, Alfred** [DE/DE]; Richard-Wagner-Strasse 27, 69214 Eppelheim (DE).

(74) Agent: **RICKER, Mathias**; Jones Day, Prinzregentenstrasse 11, 80538 München (DE).

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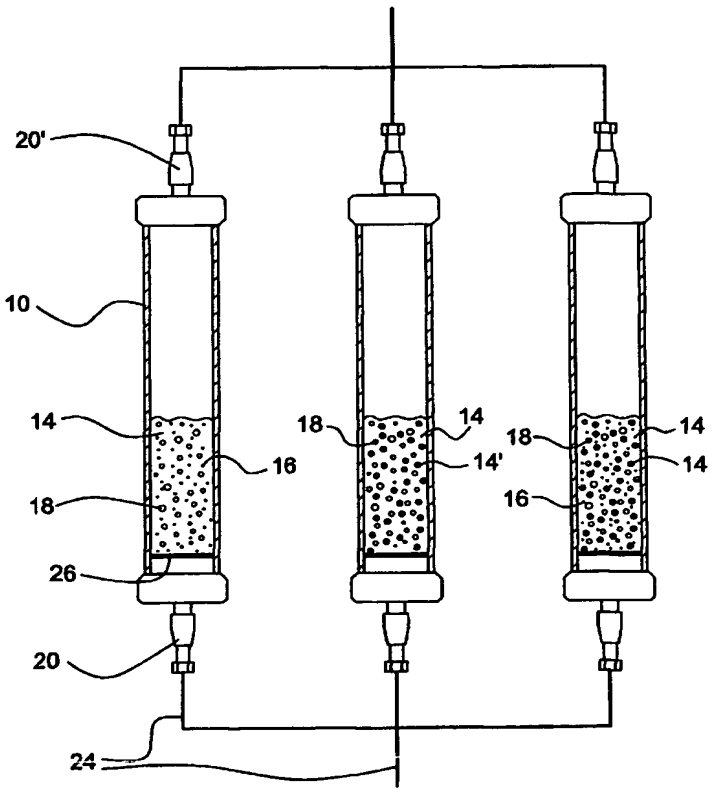
(54) Title: DEVICE AND PROCESS FOR THE SIMULTANEOUS AGITATION OF REACTION MIXTURES



(57) Abstract: The present invention is in the field of the high-throughput research for liquid and multi-phase reactions. Thereby, the invention relates to a process for the simultaneous realization of at least one chemical reaction in at least two separate reaction vessels (10), wherein said process comprises at least the following steps: (i) providing at least one reaction mixture per reaction vessel (10); to (ii) pneumatic agitation of the reaction mixture in at least one reaction vessel by means of bringing the reaction mixture into contact with at least one fluid phase (18), wherein the at least one chemical reaction is carried out in at least one of the reaction vessels (10) in the batch mode and the reaction mixture contains at least one liquid phase (14). Thereby, the fluid phase (18) is supplied to the at least one reaction vessel (10) within a defined period and is at least partially discharged from the reaction vessel. The reaction mixturee may firther comprise another immiscible liquid phase (14') and/or solid phase (16). Furthermore, the present invention relates to the device, which pertains to the process.

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AMENDED CLAIMS

[received by the International Bureau on 17 September 2004 (17.09.04);
original claims 1-20 replaced by amended claims 1-20]

1. Process for the simultaneous realization of at least one chemical reaction in at least two separate reaction vessels (10), wherein said process comprises at least the following steps:

(i) providing at least one reaction mixture (12) per reaction vessel;

(ii) agitation of the reaction mixture in at least two reaction vessels by flowing at least one fluid phase (18) through the reaction mixture,

wherein

(iii) the reaction mixture contains at least one liquid phase (14) and

(iv) at least one chemical reaction in at least one reaction vessel is operated by means of not continuously supplying reactants, but in intervals, and by not discharching reaction products continuously (batch mode), and

(v) at least two reaction vessels are parallelly supplied with the fluid phase for agitation of the reaction mixture.

2. Process as claimed in claim 1, characterized in that the fluid phase for agitation of the reaction mixture is supplied over a defined period and is at least partially discharged from the reaction vessel.

3. Process as claimed in claim 2, characterized in that by means of adjusting the flow rate of supply and discharge, a stationary state is reached with regard to the fluid for agitation of the reaction mixture, which flows through the reaction vessel.

4. Process as claimed in at least one of the preceding claims, characterized in that the reaction mixture contains at least one of the following further constituents:

at least one second liquid phase, which is not miscible with the at least one liquid phase of the reaction mixture;

at least one solid.

5. Process as claimed in claim 4, characterized in that the at least one second liquid phase or the solid or both comprises/comprise at least one catalyst, wherein the catalyst can be homogeneous or heterogeneous and solid or fluid.

6. Process as claimed in claim 5, characterized in that at least two catalysts are provided in at least two reaction vessels, which can be the same or different.

7. Process as claimed in at least one of the preceding claims, characterized in that the reaction mixtures for each reaction vessel are freely selectable independently from each other.

8. Process as claimed in at least one of the preceding claims, characterized in that the at least one fluid phase for the agitation of the reaction mixture takes part in the reaction or is inert.

9. Process as claimed in at least one of the preceding claims, characterized in that at least one of the parameters, which can be adjusted in at least one of the reaction vessels, is varied at least temporarily and/or also in sections.

10. Process as claimed in claim 9, characterized in that the at least one parameter is selected from the group comprising: temperature in the reaction vessel, reflux temperature, pressure in the reaction vessel, pressure in at least one means for supply, duration of the reaction, duration of the supply of the at least one fluid phase for agitation; quantity of fluid, which flows through, superficial velocity, concentration of the at least one fluid phase for agitation.

11. Process as claimed in claim 10, characterized in that the control of the parameters in all reaction vessels is carried out in the same manner, or is carried out in at least two reaction vessels in a different manner.

12. Process as claimed in at least one of the preceding claims, characterized in that a homogeneous or a heterogeneous flow condition exists in the reaction vessels.

13. Device for the simultaneous realization of at least one chemical reaction in an array of reaction vessels, wherein said device comprises at least the following components:

(i) at least two separate reaction vessels (10) with at least one reaction mixture (12) per reaction vessel;

(ii) at least one means for parallel supply (20) of at least one fluid phase (18) in at least two reaction vessels,

wherein

(iii) the means for supply has to be formed in a manner that it allows the agitation of the reaction mixture in at least two reaction vessels by means of the fluid phase, and

(iv) the reaction vessels are sealed during reaction with respect to the reactants.

14. Device as claimed in claim 13, characterized in that the supply of the fluid phase is carried out by means of a plurality of means for supply, which are connected materially with each other.

15. Device as claimed in claim 13 or 14, characterized in that the device comprises at least one further component, wherein said at least one further component is selected from the group comprising:

at least one further means for supplying at least one fluid,
at least one means for fluid flow control,
at least one means for phase separation,
at least one means for fluid metering,
at least one means for insertion of a fluid phase at a position within the reaction mixture,
at least one means for adjustment of parameters,
at least one by-pass.

16. Device as claimed in claim 15, characterized in that (i) the means for phase separation is a membrane or a frit or a reflux condenser or a combi-

nation thereof, or that (ii) the means for adjustment of parameters is a heating unit, a cooling unit, a pressure controller, a valve, a flow controller, or a combination thereof, or that (iii) the means for fluid flow control is a package of ball-shaped bodies or an arrangement of plates, or that (iv) the means for insertion is a nozzle, a tube or a capillary, an injector, a frit, or a combination thereof, as well as an (v) arbitrary combination of the means (i) to (iv).

17. Device as claimed in at least one of the claims 13 to 16, wherein the reaction vessel is cylindrical and has an inner diameter of from 3 mm to 50 mm and/or a height of from 150 mm to 350 mm.

18. Device as claimed in any one of the claims 13 to 17, characterized in that the individual reaction vessels are operated in parallel and/or are operated at least partially in series.

19. Device as claimed in any one of the claims 13 to 18, characterized in that each reaction vessel has at least two means for supplying at least one fluid, wherein the one means serves for the supply of the at least one fluid for pneumatic agitation and the at least one other means for supply serves for the at least partial discharge of said fluid.

20. Use of the process as claimed in any one of the claims 1 to 12 or of the device as claimed in any one of the claims 13 to 19 for reactions, in which at least one liquid phase takes part, in particular for oxidations, hydrogenations, hydrohalogenations, halogenations, hydroformulations, ozonolysis, carboxylations, alkylations, fermentation reactions, polymerisation reactions, manufacture of inorganic solid bodies, waste water treatment, Fischer-Tropsch-synthesis.